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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



RECTIFICATION

Applicant's or agent's file reference 4506PTWO/er	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB 03/04311	International filing date (day/month/year) 30.09.2003	Priority date (day/month/year) 30.09.2002 ✓
International Patent Classification (IPC) or both national classification and IPC F01D15/10		
Applicant FERRARO, Giuseppe ✓		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet. ✓
- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 4 sheets. ✓

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 30.09.2003 27 04 2004 ✓	Date of completion of this report 28.12.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Steinhauser, U Telephone No. +31 70 340-4171 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**International application No. **PCT/IB 03/04311****I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*):

Description, Pages

2-6 as originally filed
1, 1a received on 01.10.2004 with letter of 30.09.2004

Claims, Numbers

1-13 received on 01.10.2004 with letter of 30.09.2004

Drawings, Sheets

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Yes: Claims	1-13
	No: Claims	
Inventive step (IS)	Yes: Claims	1-13
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

**2. Citations and explanations
see separate sheet**

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EXAMINATION REPORT - SEPARATE SHEET**Re Item V**

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following document:

D1: US-A-5 577 385 (KAPICH DAVORIN D) 26 November 1996 (1996-11-26)

2 The subject-matter of independent claim 1 is relatively unclear (Art. 6 PCT) because it is not evident what is meant by the formulation that the bladed reversible impeller (11) has a common blade with said fluid conveyor (7):

However, in the light of the description the technical features of the device handling and recovering kinetic energy in a fluid were interpreted in the following way:

- the fluid conveyor (7) having two converging spirals (15,16) for fluid input and fluid output with a radial inlet (15') and a radial outlet (16') respectively;
- the impeller being in communication with the respective inlet (15') and outlet (16') and having a radial inlet/radial outlet configuration, i.e. the fluid is turned by 180° while passing through the impeller.

2.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and shows (the references in parentheses applying to this document) a device for handling and recovering kinetic energy in a fluid. The device comprises a bladed reversible impeller (72), a reversible engine/generator (83) integral with the bladed impeller (72) and a fluid conveyor (71,81,86,88) which cooperates with the impeller to handle and recover the kinetic energy from the fluid.

The subject-matter of claim 1 as it was interpreted differs from this known device in that the fluid conveyor has two converging spirals for fluid input and fluid output with a radial inlet and a radial outlet and in that the impeller has a radial inlet/radial outlet configuration.

The subject-matter of claim 1 is therefore new (Art. 33(2) PCT).

3 The problem to be solved by the present invention may be regarded as overcoming the problems with boosting an internal-combustion engine such as

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EXAMINATION REPORT - SEPARATE SHEET

turbo lag due to high inertia or lack of power in the exhaust gas at certain speeds.

The solution to this problem proposed in claim 1, as it was interpreted, of the present application is considered as involving an inventive step (Art. 33(3) PCT) for the following reasons: the device for handling/recovering the kinetic energy in a fluid is compact, simple and capable of operating as an autonomous blower and as a device to recover kinetic energy of a fluid thereby generating energy. The fluid conveyer is a scroll having two adjacent converging spirals for fluid input and fluid output fluidly connected to an impeller which is of the radial inlet/radial outlet type.

This configuration is not disclosed nor hinted at in the available prior art and hence the device is also considered inventive (Art. 33(3) PCT).

- 4 Claims 2-13 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 5 The invention is industrially applicable in the field of supercharged internal combustion engines (Art. 33(4) PCT).

Field of the invention

This invention concerns a device to handle and recover the kinetic energy in a fluid.

Prior art

5 The current state of technique relevant i.e. to the internal-combustion engine boosting, generally makes use of mechanical systems such as turbo superchargers or mechanical drive positive displacement blowers. These devices compress and meter the air delivered to the engine using an approximate method which is inconsistent with the engine needs. This is caused by inaccurate driving
10 devices; by high inertias or by lacking power at a certain speed (rpm) or excessive power at other speeds.

As an example of the current state of technique, US-A-5577385 shows an electropneumatic supercharger comprising an electric motor, a compressor (centrifugal blower) with its own blading and a separate air turbine having its own
15 blading.

Any other engine subsidiary system is almost completely electronically driven, due to performances reasons and needs set by problems relevant to energy consumption and environment preservation.

However, the need for an air handling system has not yet been met
20 throughout the world many attempts are currently being made to meet this need, making use either of an electrically driven external device to avoid turbo superchargers classic response delay or making use of electric engine supported turbo superchargers. As a part of it, the electrical engine is stressed by the same speed (rpm) and the same temperature as the turbo supercharger.

25 Brief description of the drawings

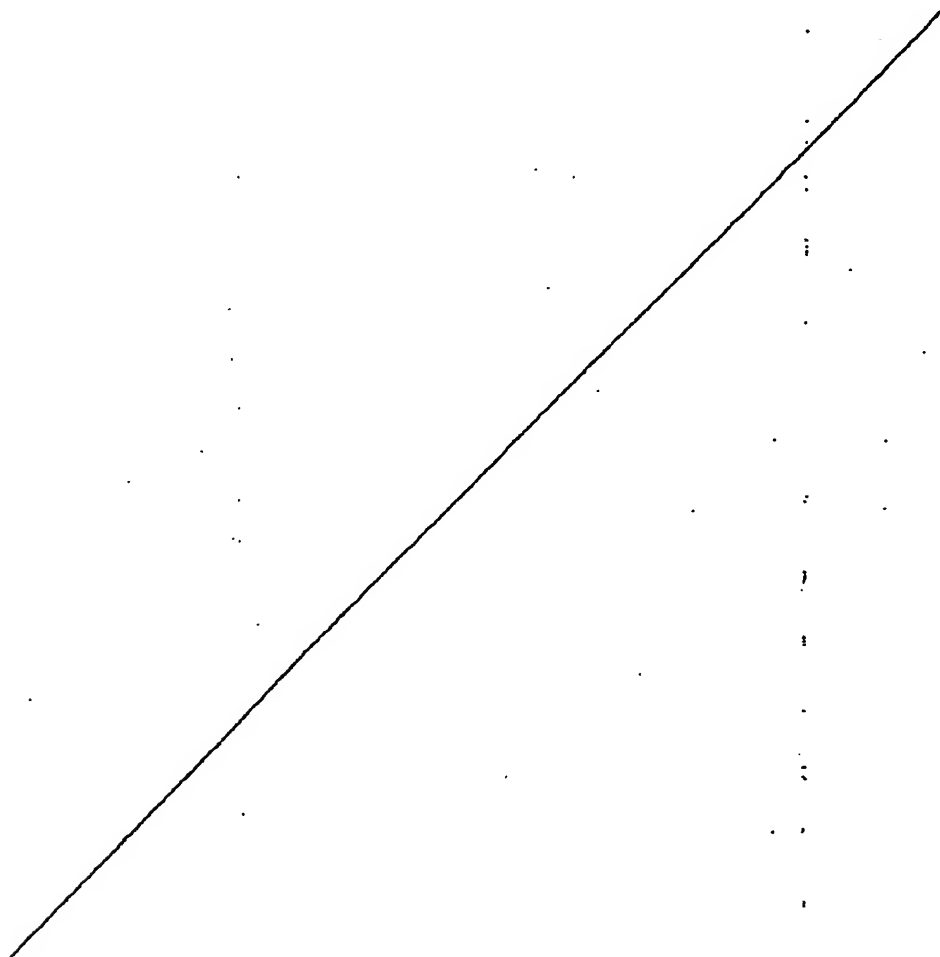
Figure 1 shows a three-dimensional section plane of the reversible bladed impeller that is the subject of this invention;

- figure 2 shows a front view;
- figure 3 shows an A-A longitudinal section;
- 30 - figure 4 shows a three-dimensional exploded view;
- figure 5 shows the diagram of the application of the device to an engine system.

- 1a -

Detailed description of the invention

The purpose of this invention is to overcome all the over mentioned inconveniences introducing a reliable device to completely handle and recover the



NEW CLAIMS

1. Device for handling and recovering kinetic energy in a fluid, characterised in that it comprises:

- a bladed reversible impeller (11);
- 5 - a reversible engine/generator (12) integral with the bladed impeller;
- a fluid conveyor (7) which cooperates with the impeller to handle and recover the kinetic energy of the incoming fluid;

said bladed reversible impeller (11) having a common blade with said fluid conveyor (7), and being either supplied by a fluid through said fluid conveyor (7);

- 10 in such a way as it can slow down and convey mechanical power to the engine/generator (12), operating as an electric generator, or being accelerated by the engine/generator (12), operating as an engine, in such a way as to operate as a centrifugal blower delivering fluid under pressure by means of the fluid conveyor (7).

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2. Device as in claim 1, characterised in that said fluid conveyor (7) comprises:

- a convergent spiral of the fluid inlet (15) that receives the incoming fluid;
- a divergent spiral of the fluid outlet (16) that generates an outgoing fluid

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3. Device as in claim 2, characterised in that said fluid conveyor (7) includes also a duct (17) for recirculation or partial exhaust of excess fluid.

4. Device as in claim 1, characterised in that said engine/generator (12) is integral with the bladed flow impeller (11) by means of a shaft.

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5. Device as in claim 1 characterised in that said engine/generator (12) is a high efficiency permanent magnet brushless electric three-phase synchronous machine which is supplied, as an engine, with alternate three-phase variable high frequency current and outputs as a generator an alternate three-phase current.

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6. Device as in any of the previous claims, characterised in that it is a single assembly body also comprising:

- an engine/generator (11) casing (8) equipped with cooler;
- a rear cover (9) integral with the said casing (8);

- a front cover (10) with relevant cooler, integral with the said fluid conveyor (7),

such single body containing inside the said engine/generator (12), the bladed impeller (11) and shaft (13).

5 7. Device as in claim 6, characterised in that said rotation shaft (13) is inserted in the said front and rear covers (9,10) by means of antifriction bearings (14).

8. Device as in any of the previous claims, characterised in that it is made of aluminum alloy or stainless steel or titanium or ceramic material or composite materials such as fiber reinforced techno polymer.

9. Overcharged engine including a turbo supercharger, characterised in that it comprises a device as in any of the previous claims, assembled in series between the said turbo supercharger and the engine pressurized fluid inlet.

10. Engine as in claim 9, characterised in that it is a road trailer internal combustion engine.

11. Engine as in claim 9, characterised in that it is an aviation piston propulsor.

12. Engine as in claim 9, characterised in that it is an internal combustion engine for marine propulsion.

13. Engine as in claim 9, characterised in that it is a two-stroke-cycle internal combustion engine.